PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2002-241982
(43)Date of publication of application : 28.08.2002

(51)Int.Cl. C25D 1/02
G02B 6/38

(21)Application number : 2001-038345
(22)Date of filing : 15.02.2001

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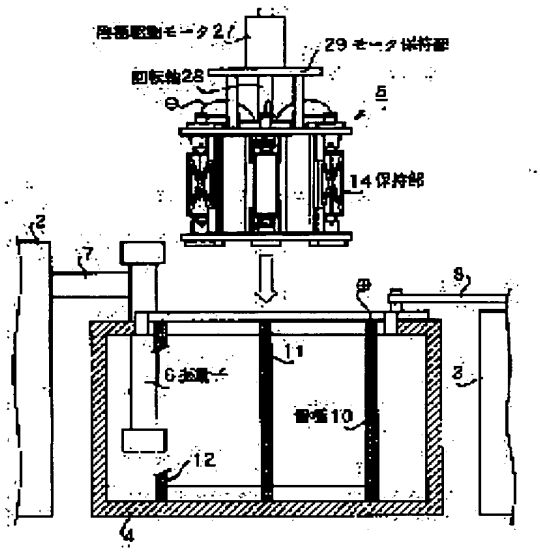
(54) METHOD FOR PRODUCING FERRULE FOR OPTICAL FIBER CONNECTOR BY ELECTROFORMING

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a method for producing ferrules for optical fiber connectors by electroforming suitable for mass production wherein an electroforming layer can be formed uniformly on a core material surface and the drawing out work of the core wire can be performed easily without requiring skill.
SOLUTION: A core wire 19 is constituted by inserting an inner core wire into an outer core tube and clamping the resultant assembly by an outer core tube holding part 16. The obtained unit is vertically fixed to a holding part 14 and dipped into an electroforming tank 4 containing nickel sulfamate, for example. Each holding part is made to rotate on its own axis with a cathode driving motor 27, and an anode disposed at the outer periphery of the holding part 14 is made to revolve around the holding part. A specified voltage and electric current are applied between the cathode and anode, ultrasonic agitation is applied to the bath, and a holding device 5 is pulled up after the lapse of a necessary time. The core wire on which electroforming is performed is removed from the holding part, and the inner core wire is drawn out by sandwitching the outer core tube holding part 16. The ferrule for the optical fiber connectors is completed by cutting the outer core tube with which electroforming formation has been carried out to a predetermined length and then finishing the core tube.



CLAIMS

[Claim(s)]
[Claim 1]Inside SUS304 or a metal small tube of covar, a metaled small-gage wire or super-high-density polyethylene of SUS304, A core wire which inserted and reinforced super-tensile strength fiber bunches, such as a poly aramid fiber, is manufactured, It is immersed in a electrocasting tub by using said core wire as the negative pole, and an electroforming layer is formed in a periphery of said core wire, A metaled small-gage wire or a synthetic fiber bunch which pulls up a core wire in which said electroforming layer was formed from said electrocasting tub, and constitutes the inside of this core wire is removed, A manufacturing method of a ferrule for optical connectors by electrocasting finishing a metal small tube and a tubular object formed of a electrocasting tub of the periphery in a predetermined size.
[Claim 2]A manufacturing method of the ferrule for optical connectors according to claim 1 inserting a sandwiching part in a small-gage wire or a super-tensile strength fiber bunch of said metal so that said metal small tube may be contacted, grasping said sandwiching part after electroforming layer formation in it, and drawing out a small-gage wire or a super-tensile strength fiber bunch of said metal in it.
[Claim 3]Arrange a core wire which immerses in said electrocasting tub one or more, and it is made to rotate on the circumference to a electrocasting tub center, The one or more anodes are arranged to a peripheral part of said one or more core wires, A manufacturing method of the ferrule for optical connectors according to claim 1 or 2 forming a uniform electroforming layer in said core wire by sending current between said negative pole and the anode, making said one or more anodes revolve around the sun by making said electrocasting tub center into a center of rotation.
[Claim 4]A manufacturing method of the ferrule for optical connectors according to claim 3 holding said one or more core wires at right angles to electrocasting bath liquid, rotating rotating velocity of a core wire abbreviated 10 in 1 minute, and rotating a revolution speed of said one or more anodes abbreviated 1 in 1 minute.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the method of manufacturing the ferrule for optical connectors, etc. by electrocasting.
[0002]
[Description of the Prior Art]The optical fiber is supported with the tubular part in which the connector for optical fibers is called a ferrule (cap) to the central part. Ferrules are tubular parts which have fine pores of the shape of a perfect circle 0.13 mm in diameter in the center. The centers of this ferrule are compared correctly and connection of the optical fiber by a connector is achieved.
[0003]Now, the ferrule is manufactured by the following process. The mixture of zirconia powder and resin is cylindrically fabricated by injection molding, extrusion molding, etc., and a pitch is ****(ed) by 500-degree Centigrade. After calcinating by 1200 more degree Centigrade, an outside dimension is finished by polish. Then, a breakthrough 0.13 mm in diameter is opened with the gimlet of a diamond, and the center is completed. This work is a construction method to be become skillful by the work person, therefore that serviceability was restricted. Production of this ferrule and restrictions of serviceability have been the greatest obstacle of worldwide installation nationally [a fiber-optic network].
[0004]
[Problem(s) to be Solved by the Invention]As a method of solving this, cylindrical parts are manufactured by electrocasting by using a conductive core wire as the negative pole, and how to carry out dissolution removal of this core wire with a strong base etc. can be considered. However, since the fine pores are 0.130 mm in diameter, a strong alkali solution does not permeate an inside but actual manufacture is impossible. Although how to manufacture a ferrule by drawing out this core wire can be considered, it does not become practical use from shortage of the tensile strength of a core wire to draw out the core wire used as the negative pole cutting a core wire in the drawing process of a core wire in many cases.
[0005]The electrode immersed in the bath liquid of a electrocasting tub had the common method of the negative pole and the anode being fixed, making rotate only the negative pole, or moving. This is for forming in a core wire and concentric circle shape as much as possible, when forming a cylindrical thing by electrocasting. However, when the negative pole is made to revolve around the sun, since it is influenced by the bath liquid of a electrocasting tub, the homogeneous thing formed cylindrically is difficult. There is the purpose of this invention in providing the manufacturing method of the ferrule for optical connectors by electrocasting suitable for mass production which can do the drawing work of a core wire easily without requiring skill while it solves many above-mentioned problems and forms an electroforming layer in a core surface uniformly.
[0006]
[Means for Solving the Problem]In order to attain said purpose, a manufacturing method by this invention, Inside SUS304 or a metal small tube of covar, a metaled small-gage wire or super-high-density polyethylene of SUS304, A core wire which inserted and reinforced super-tensile strength fiber bunches, such as a poly aramid fiber, is manufactured, It is immersed in a electrocasting tub by using said core wire as the negative pole, and an electroforming layer is formed in a periphery of said core wire, A metaled small-gage wire or a synthetic fiber bunch which pulls up a core wire in which said electroforming layer was formed from said electrocasting tub, and constitutes the inside of this core wire is removed, and it is constituted so that a metal small tube and a tubular object formed of a electrocasting tub of the periphery may be finished in a predetermined size. This invention is constituted so that a sandwiching part may be inserted in a small-gage wire or a super-tensile strength fiber bunch of said metal so that said metal small tube may be contacted, said sandwiching part after electroforming layer formation may be grasped in it and a small-gage wire or a super-tensile strength fiber bunch of said metal may be drawn out in it in the above-mentioned manufacturing method. A core wire which furthermore immerses in said electrocasting tub in this invention, Arrange one or more, make it rotate on the circumference to a electrocasting tub center, and the one or more anodes are arranged to a peripheral part of said one or more core wires, Making said one or more anodes revolve around the sun by making said electroforming device center into a center of rotation, by sending current between said negative pole and the anode, it is constituted so that a uniform electroforming layer may be formed in said core wire. Furthermore, this invention holds said one or more core wires at right angles to electrocasting bath liquid in the above-mentioned manufacturing method, rotating velocity of a core wire is rotated abbreviated 10 in 1 minute, and a revolution speed of said one or more anodes is constituted so

that it may be made to rotate abbreviated 1 in 1 minute.
[0007]
[Function]According to the above-mentioned manufacturing method, the mass production of the ferrule for optical connectors of which accuracy is required as 1.5 mm - about 2.5 mm very thinly of an outer diameter is attained, for example.
[0008]
[Embodiment of the Invention]Hereafter, with reference to drawings, an embodiment of the invention is described in detail. The perspective view and drawing 2 in which the embodiment of the electrocasting forming device used for drawing 1 with the manufacturing method of the ferrule for optical connectors by this invention is shown are a sectional view showing the state where the supporting structure is immersed in a electrocasting tub. The supporting structure 5 is immersed in the electrocasting tub 4, and an electroforming layer is formed in the core wire attached to the pivotable attaching part 14. Churning of the bath liquid of the electrocasting tub 4 is performed by the ultrasonic wave generated with the ultrasonic agitating device 2. An ultrasonic output is transmitted to the vibrator 6 arranged in the bath liquid of the electrocasting tub 4 via the ultrasonic transfer arm 7.
[0009]The four anodes 10, 11, 12, and 13 are arranged at intervals of 90 degrees on the circumference to the center of the electrocasting tub 4. These anode electrodes 10, 11, 12, and 13 are made to revolve around the sun at 1 time of speed in 1 minute with the anode drive motor 3. It is built over the belt 8 between the driving shaft 3a of the anode drive motor 3, and the axis of rotation 35a of the gear 35, and the output of the anode drive motor 3 is transmitted to the rotating member 37 by which the gear was provided in the periphery via the gear 36. It is fixed to the rotating member 37 and the anode electrodes 10, 11, 12, and 13 are made to revolve around the sun by rotation of the rotating member 37.
[0010]Drawing 3 is a perspective view showing the example of the supporting structure, omits a negative pole drive motor and is shown. The supporting structure 5 fixes the disks 5a and 5b to the upper and lower ends of the pillar 5c, and is constituted. The attaching part 14 which attached the core wire at intervals of 90 degrees on the circumference is attached pivotable among the disks 5a and 5b. The gears 40 and 48 are attached to the disks 5a and 5b of the supporting structure 5 pivotable, The member 48a by which the members 40b formed successively by the gear 40 were formed successively by the gear 48 on the undersurface of the disk 5a has projected in the upper part of the disk 5b, respectively, and the lobes 14b and 14c (refer to drawing 4) of the attaching part 14 are fixed to these members 40b and 48a.
[0011]It is built by the belt 41 between the pulley portion 40a of the gear 40, and the pulley portion 43a of the gear 43, and the gear 43 has geared to the rotating member 44 by which the gear was provided in the periphery. The gear 40 gears on the gear 45 and the gear 48 has geared on the gear 47, respectively. The gear 48 and the gear 47 are connected with the axis 46. The above-mentioned transmission mechanism is installed to four attaching parts arranged at intervals of 90 degrees. As shown in drawing 2, the negative pole drive motor 27 is fixed on the motor holding stand 29, and the axis of rotation 28 of the negative pole drive motor 27 is being fixed to the rotating member 44. Therefore, the rotational output of the negative pole drive motor 27 is transmitted to the gear 40 via the axis of rotation 28, the rotating member 44, and the belt 41, is further transmitted to the gear 48 via the gear 45, the axis 46, and the gear 47, and makes the attaching part 14 and other three attaching parts rotate.
[0012]Drawing 4 is a figure showing the example of an attaching part, a front view and (b) show a top view, (c) shows a side view, and, as for (a), (d) shows the perspective view, respectively. The longitudinal dimensions of the attaching part 14 are four rectangular flasks, and both side surfaces serve as the X-like lattice frame 14a. In the upper and lower ends, it has the lobes 14b and 14c fixed to the member 40b by the side of the disk 5a, and the member 48a by the side of the disk 5b. In the lobe 14c, the coiling part 22 which twists the lower end 19b of the core wire 19 is formed.
[0013]It is fixed by the holding part 34, and the tip used as a lower end is fitted in the breakthroughs 31a and 31b of the attaching part 14, and the upper bed 19a of the core wire 19 is twisted and fixed to the coiling part 22. As shown in 34 of drawing 5 (a), when it is immersed in bath liquid and electroforms in this state, many electroforming layers to the upper-and-lower-ends [of a core wire] 34a andb [34] side formed adhere. So, in this invention, as shown in drawing 5 (b), the shields 20 and 21 (shields 38a and 38b of drawing 3) are attached to the vertical section of the attaching part 14. Thus, the attaching part 14 which attached the core wire 19 is fixed to the member 40b of the disk 5a, and the member 48a of the disk 5b as the lobes 14a and 14b mentioned above.
[0014]Drawing 6 is a figure showing the example of the structure of connecting the negative pole to a core wire, (a) shows the front view near the core wire upper part, and (b) shows the perspective view near a negative pole terminal area, respectively. The upper bed 19a of the core wire 19 is connected to the member 40b with the screw 33, and the screw 33 is electrically connected with the belt pulley 40a. The hole 40b is formed in the upper surface of the belt pulley 40a. The cathode terminal 23 is inserted in the hole 40b, even if the belt pulley 40a rotates, it slips, and the cathode terminal 23 does not rotate, and an electrical link is held. The lead 24 connected to the negative terminal of the power supply which is not illustrated is connected to the cathode terminal 23.
[0015]Drawing 7 is a figure showing the example of a core wire, and the perspective view of the core wire for which an outside core tube and (b) were assembled as for (a), and an outside core tube sandwiching part and (c) were assembled as for an inner core line and (d) is shown, respectively. Cut processing of the outside core tube 15 which is a metal small tube is carried out to 220 mm in length using a with 0.13 commercial mm in inside diameter, and an outer diameter of 0.31 mm stainless steel (SUS304) pipe. It cuts in length of 420 mm by making the pure stainless-lines material of 0.12 mm in diameter SUS304 into the inner core line 17, and this is inserted in the outside core

tube 15. And outside 20 mm in length inserts the core tube sandwiching part 16 in the both ends of the inner core line 17. On both sides of the insulating film pipe 18, it has insulated between the outside core tube 15 and the outside core tube sandwiching part 16. After electrocasting formation, since a crack is not given to a electrocasting element tube when drawing out the inner core line 17, it is for pliers and other grasping tools drawing out on both sides of the outside core tube sandwiching part 16. It is also possible to use the metal small tube of covar as the outside core tube 15, and to use super-tensile strength fiber bunches, such as super-high-density polyethylene and a poly aramid fiber, as the inner core line 17.

[0016]The ferrule for optical connectors is manufactured by the following processes. First, as shown in drawing 4, drawing 5, and drawing 6, the upper bed 19a of the core wire 19 is fixed to the attaching part of the supporting structure 5 for the core wire 19 constituted like drawing 7 by the holding part 34, and the tip is rolled round to the breakthroughs 31a and 31b of the attaching part 14 at through and the coiling part 22, and it fixes. The core wire 19 is similarly attached about four attaching parts, and the supporting structure 5 is immersed in the electrocasting tub 4.

[0017]Although [various] existence of the bath liquid of the electrocasting tub 4 is recognized, since nickel amiosulfonate is suitable in respect of the homogeneity of electrocasting, etc., it uses this. Management is easy also to the little of influence on an employee's health, and environmental-standards regulation of administration. Since the electrocasting bath liquid of nickel amiosulfonate of specific gravity 1.5 is excellent at the speed of electrocasting formation, etc., if this is used, it can increase manufacture speed. A electrocasting formation speed is reduced by half in the electrocasting bath liquid of specific gravity 1.3. The core wire 19 is vertically held by the electrocasting tub 4 by the supporting structure 5. Revolution of an anode portion is 1 time in 1 minute, and the attaching part of a core wire is made to rotate about 10 times in 1 minute. It is required to install so that the core wire 19 may not broadcast within bath liquid, and an attaching part needs for a core wire to be always vertical also in rotation.

[0018]The anode puts spherical nickel into the basket made from titanium, and is an installation method with that common of a wrap with the bag of a synthetic fiber. However, in this invention, in order to electroform uniformly to the core wire which is the negative pole, as mentioned above, while rotating a core wire about 10 times in 1 minute, the electrocasting stick of the sectional shape near a perfect circle can be formed by rotating the anode one time in 1 minute. An ultrasonic wave is used for churning because it became clear in churning by air that it had influence on the tracking of a core wire. It turned out that an unexpected ripple generates churning by a low frequency wave in electrocasting. It is because it became clear that influence had least ultrasonic churning experimentally.

[0019]It is as drawing 5 (a) having explained that in the case of electrocasting electrocasting will be promoted for the portion near a terminal compared with a core wire center section, and a small tube will be formed in a hard drum form. When performing electrocasting to a core wire with an outer diameter of 0.31 mm especially, the portion near the terminal of 220 mm in length a core wire and the portion fixed to the lower bottom plate progress earlier than formation of a core wire center section, for example, it has become 2.4 mm to the central part being formed only in the outer diameter of 1.5 mm. Therefore, the shield as shown in drawing 5 (b) was attached. Thereby, electrocasting became possible by fixed thickness to a core wire 220 mm in length.

[0020]Although direct-current 7-10 A/dm^2 of the direct current used by electrocasting was carried out in the elementary explanatory, a direct current of 3.4V and 27A was energized between the anode and the negative pole in this invention. The bath liquid which used nickel amiosulfonate as the main ingredients to the small tube with an outer diameter of 0.3 mm by this was able to be held to 55-degree Centigrade, and the cylindrical element tube with an outer diameter of 2.5 mm was able to be formed in 6 hours.

[0021]After predetermined carries out time immersion by the above-mentioned conditions, the supporting structure 5 is pulled up from the electrocasting tub 4, and the core wire 19 in which electrocasting was formed from the attaching part 14 is removed. The core tube sandwiching part 16 is drawn out outside the core wire 19, it holds with a jig and the inner core line 17 is drawn out. Big hauling tension is not applied to drawing and it can extract easily. Thus, the electroformed outside core tube is cut to predetermined length, necessary finishing is carried out, and it is considered as the ferrule for optical connectors.

[0022]Although an above embodiment showed the example which has arranged four core wires, in order to improve mass production nature further, it is possible to enlarge the radius of a periphery and to install four or more on a periphery. Although the rotating velocity of a core wire and the revolution speed of the anode were made into 10 times and 1 time in 1 minute, respectively, it is not limited to this speed.

[0023]

[Effect of the Invention]As mentioned above, as explained, this invention inside SUS304 or the metal small tube of covar, The core wire which inserted and reinforced super-tensile strength fiber bunches, such as a small-gage wire of the metal of SUS304 or super-high-density polyethylene, and a poly aramid fiber, is manufactured, The metaled small-gage wire or synthetic fiber bunch which pulls up the core wire which immersed in the electrocasting tub by having used the core wire as the negative pole, and formed the electroforming layer in the periphery of a core wire, and in which the electroforming layer was formed from a electrocasting tub, and constitutes the inside of a core wire is removed, and a predetermined size is made to a metal small tube and the tubular object formed of the electroforming layer of the periphery. Therefore, an electroforming layer can be uniformly formed in a core surface, the drawing work of a core wire can be done easily, without requiring skill, and it is effective in the ability to provide the ferrule for optical connectors suitable for mass production by electrocasting.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is a perspective view showing the embodiment of the electrocasting forming device used with the manufacturing method of the ferrule for optical connectors by this invention.
[Drawing 2]It is a sectional view showing the state where the supporting structure is immersed in a electrocasting tub.
[Drawing 3]It is a figure showing the example of the supporting structure, and the perspective view which (a) omitted the negative pole drive motor and was shown, and (b) are front views. .
[Drawing 4]It is a figure showing the example of an attaching part, and, as for a front view and (b), a side view and (d of a top view and (c)) are [(a)] perspective views.
[Drawing 5]It is a figure for explaining the position which installs a shield.
[Drawing 6]With the figure showing the example of the structure of connecting the negative pole to a core wire, as for (a), the front view near the core wire upper part and (b) show the perspective view near a negative pole terminal area, respectively.
[Drawing 7]The figure showing the example of a core wire shows the perspective view of the core wire for which an outside core tube and (b) were assembled as for (a), and an outside core tube sandwiching part and (c) were assembled as for an inner core line and (d), respectively.
[Description of Notations]
1 Electrocasting forming device
2 Ultrasonic agitating device
3 Anode drive motor
4 Electrocasting tub
5 Supporting structure
6 Vibrator
7 Ultrasonic transfer arm
8 Belt
10, 11, 12, and 13 Anode
14 Attaching part
15 Outside core tube
16 Outside core tube sandwiching part
17 Inner core line
18 Insulating film pipe
19 Core wire
20 Shield
22 Coiling part
23 Cathode terminal
24 Lead
27 Negative pole drive motor
28 Axis of rotation
29 Motor holding stand
32 Holding part
33 Thread part

[Translation done.]

* NOTICES *

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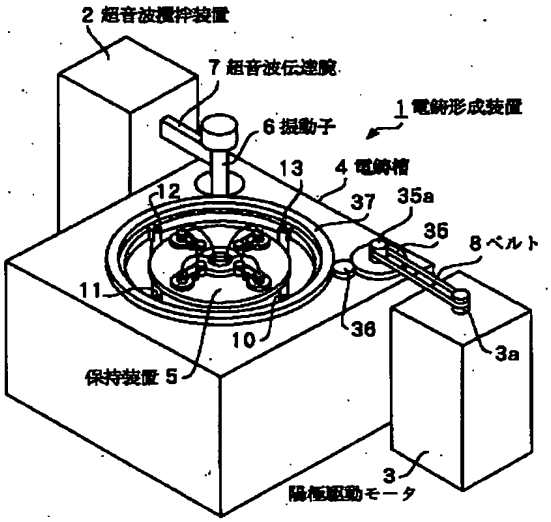
damages caused by the use of this translation.

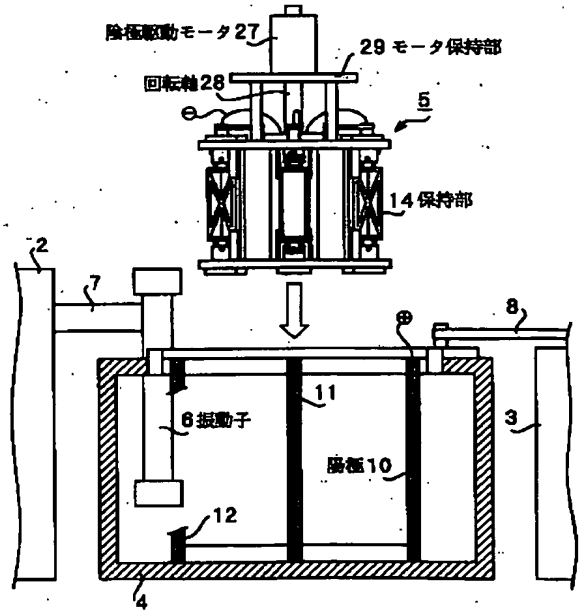
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

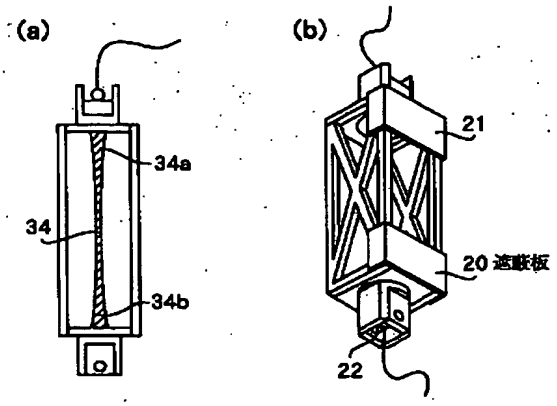
[Drawing 1]



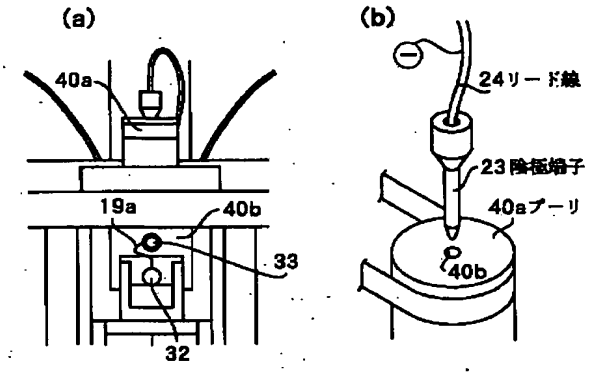
[Drawing 2]



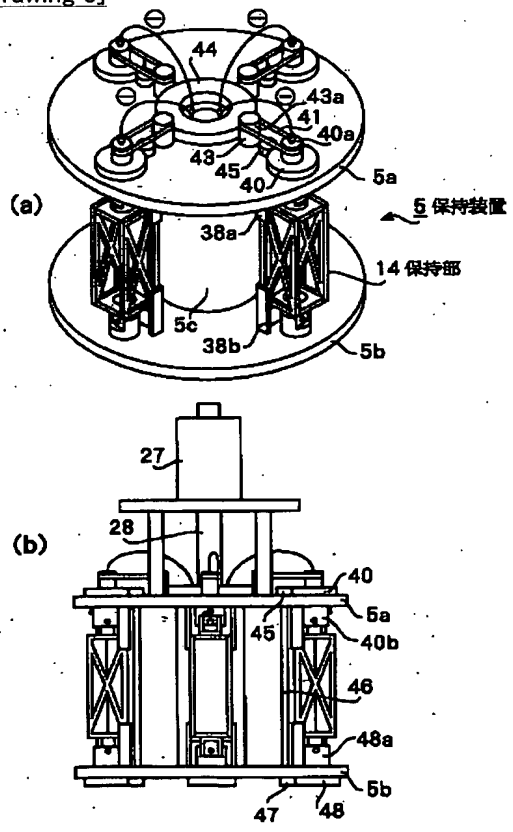
[Drawing 5]



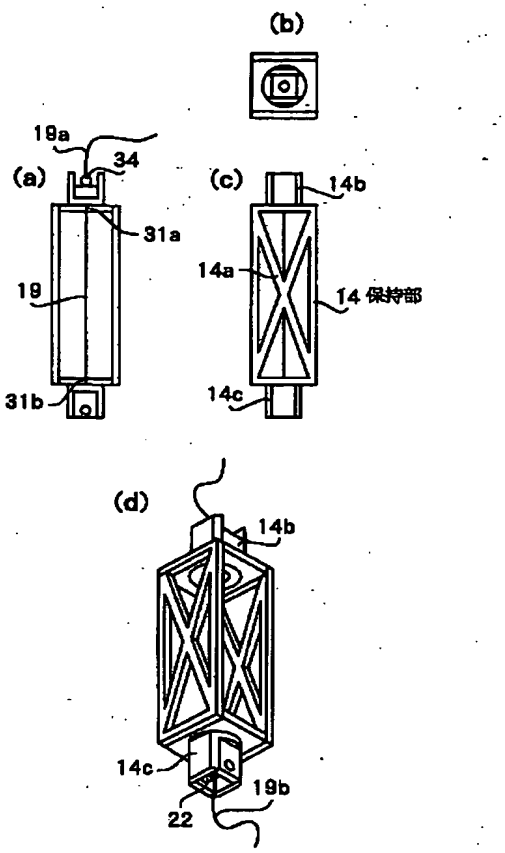
[Drawing 6]



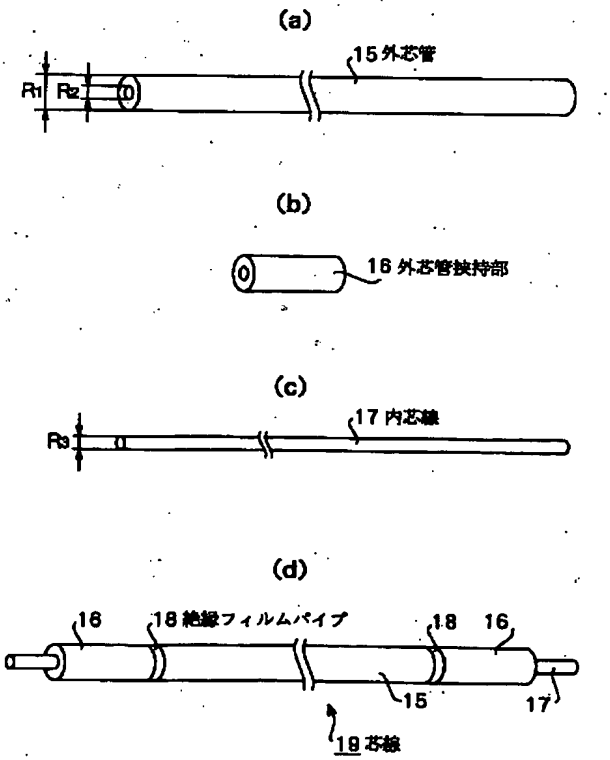
[Drawing 3]



[Drawing 4]



[Drawing 7]



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(19)日本国特許庁（ＪＰ）　(12)公開特許公報（Ａ）　(11)特許出願公開番号
特開2002－241982
（P2002－241982A）
(43)公開日　平成14年８月28日(2002.8.28)

(51)Int.Cl.⁷	識別記号	ＦＩ		テーマコード（参考）
Ｃ２５Ｄ　1/02		Ｃ２５Ｄ	1/02	２Ｈ０３６
Ｇ０２Ｂ　6/38		Ｇ０２Ｂ	6/38	

審査請求　未請求　請求項の数４　ＯＬ　（全　７　頁）

(21)出願番号　特願2001－38345(P2001－38345)

(22)出願日　平成13年２月15日(2001.2.15)

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Ｆターム(参考)　2H036 QA19 QA20

(54)【発明の名称】　電鋳による光ファイバコネクタ用フェルールの製造方法

(57)【要約】
【課題】　芯材表面に電鋳層を均一に形成するとともに芯線の引き抜き作業を熟練を要することなく簡単に行える、量産に適した電鋳による光ファイバコネクタ用フェルールの製造方法を提供する。
【解決手段】　外芯管に内芯線を挿通し、外芯管挟持部１６で挟持して芯線１９が構成される。これを保持部１４に垂直に取り付け、スルファミン酸ニッケルなどの電鋳槽４に浸漬する。各保持部を陰極駆動モータ２７で自転させるとともに保持部１４の外周に配置した陽極を公転させる。陰極と陽極の間に所定の電圧，電流を加え超音波で撹拌し、所要の時間経過後、保持装置５を引き上げる。保持部から電鋳が形成された芯線を取り外し、外芯管挟持部１６を挟んで内芯線を引き抜く。電鋳形成された外芯管を所定の長さに切断して仕上げをすることにより光ファイバコネクタ用フェルールが完成する。